Photoacoustic Thermal Characterization of Photorheological Fluids

C. Vales-Pinzón [S] and J.J. Alvarado-Gil [C]
Departamento de Física Aplicada, Centro de Investigación y de Estudios Avanzados del I.P.N., Unidad Mérida, Mérida, Yucatán, México
jjag09@yahoo.com

R. Medina-Esquivel and J.A. Mendez-Gamboa
Facultad de Ingeniería de la Universidad Autónoma de Yucatán, Mérida, Yucatán, México

N. Gomez-Ortiz
Departamento de Física Aplicada, Centro de Investigación y de Estudios Avanzados del I.P.N., Unidad Mérida, Mérida, Yucatán, México

M. Arjona
Facultad de Ingeniería de la Universidad Autónoma de Yucatán, Mérida, Yucatán, México

Photorheological fluids are a kind of liquid material whose rheological properties (such as viscosity) are modified by light. These fluids can constitute an important alternative to electrorheological and magnetorheological fluids which are two-phase solutions (liquid-solids). These latter fluids show a tendency toward aggregation and sedimentation, which could be deleterious in long-term applications of smart materials. In contrast, photorheological fluids are single-phase solutions that can be structured at the nanoscale [1]. This behavior opens the possibility of controlling at will the thermal properties of those fluids. In this work, the thermal characterization of samples consisting of the cationic surfactant, cetyl trimethylammonium bromide (CTAB), and the photoresponsive organic derivative, trans-ortho-methoxycinnamic acid (OMCA) at different compositions is reported. The experiments were performed using the photoacoustic (PA) technique to study, in real time, the changes in the thermal properties induced by illumination, with UV light, of those non-reversible photorheological fluids. The liquid sample is deposited on a metallic substrate attached to a modified PA cell and the substrate is illuminated using a modulated laser beam [2]. The kinetic of photoisomerization of the samples is followed by the changes in the thermal properties. The results are discussed in terms of irradiation time exposition and can be explained in terms of the modifications induced in the molecular morphology of the photorheological liquid constitutive molecules.

[1]. Aimee M. Ketner, Rakesh Kumar, Tanner S. Davies, Patrick W. Elder, and Srinivasa R. Raghavan. J. AM. CHEM. SOC. 129, 1553-1559 (2007)
[2]. P. Martínez-Torres, J.J. Alvarado Gil, Eur. Phys. J. Special Topics 153, 65 (2008)